

**(57) Abstract:** A support apparatus (20) adapted to support mussels in an aquatic mussel harvesting operation. The apparatus has a support extension (24) that is adapted to be inserted into a harvesting support (68) that is adapted to facilitate growth of mussels. An upper surface (38) is provided to give the aquatic mussels support.

# METHOD AND APPARATUS FOR SUPPORTING AQUACULTURED MUSSELS

## BACKGROUND OF THE INVENTION

### 5 *Field of the Invention*

The device is used in the mussel aquaculture farming industry. In general the concept is a support device that attaches to a vertical attachment means which; mussels cling on to grow.

### *Background of the Invention*

10 The mussel farming industry has developed techniques of culturing and harvesting mussels. One such method is to hang substantially vertical seed collector cords or lines below the surface of the ocean. The lines are about eight to twenty feet in length and after mussels give spawn, the small larval seed mussels attach to  
15 the lines to grow. After several months the seed mussels will grow in dense clusters along the lines. When there is not sufficient space on the lines for the mussels to adequately grow further (the seed mussels are about 5mm – 30mm in length), the mussel farmer will withdraw the seed collector lines from the ocean and separate the  
20 seed mussels from the collector line.

At this point the seed or juvenile mussels are injected into a mesh tubing and reinserted back into the ocean. The mesh tubing is made from a web netting material that radially expands to a larger circumference. The mesh tubing provides more surface area for  
25 the seed mussels to cling thereon and it will support the mussels as they grow in size and grow through the mesh to a size of several inches long. As the mussels grow, they move radially outwardly through the mesh tubing in order to be able to open their valves and gather plankton from the seawater. As they increase in size the  
30 mussels rely on the mesh tubing and also the mussels below them

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for support. The mussels eventually are attached to the outside of the mesh tubing and as they grow larger they will rest upon the mussel immediately below them and that mussel will be partially supported by the mussel below it. If some of the supporting  
5 mussels loses their foothold from the mesh tubing a catastrophic collapse can occur where strips of mussels fall from the mesh tubing to the floor of the ocean bay and are unharvestable at that point.

To prevent the catastrophic loss of mussels, support rods  
10 have been used. The support rods were essentially a stick or peg about eight inches long that stuck through the diameter of the web tubing. When the seed mussels are inserted into the mesh tubing and placed back into the ocean, a support rod was placed between the holes in the mesh about every 12 – 18 inches along the eight to  
15 the entire length of mesh tubing. When the support rods were inserted into the mesh they had two extensions that extended out opposite sides of the mesh. The support rods did supply some support for the mussels that were directly above each extension of a rod; however, the support rods only had limited surface area in  
20 the horizontal plane and mussels that were ninety degrees from each extension of the support rods received no direct support from the support rod, support was only from those mussels adjacent to the mesh tubing.

### ***Background art***

25 A search to the prior art has revealed numerous embodiments in the area of aquatic culture harvesting. A brief summary of the patents that resulted in a patentability search is listed below.

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U.S. 5,653,193 Marissal, shows a mollusk raising system in which support trays 30, are supported in net tubes 24. The tubes with the included platforms are suspended in the water.

5 The invention is primarily directed to growing oysters within the net 24. As seen in Fig. 2 the tray 30 is positioned within the net 24 and can be held therein by a number of attachment means which are shown in Figs. 6 -- 14.

As seen in Figs. 16 and 17, the rope 62 extends through the apertures 40 which are located at the edge portions of the disc 30 (see figure 2). The blocking element 63 which fits into the frustoconical aperture 40 is best seen in Fig. 17, where the lugs 76 are adapted to engage the rope 62.

15 Figs. 18 -- 20 shows another fastening method where the rapid fastener 84 serves as a means to secure the tray 30 to the netting 24 where Fig. 18 is a side elevational view of the edge portions of the tray 16 which is shown in figs. 6. Apparently, the cord is wrapped around the netting and the annular groove 16 of the tray 30 and the cord ends 81 and 82 are positioned in the locking semi shells 86 and 88 of the rapid fastener 84 (see figure 20 19).

U.S. 5,515,813 Wilkerson, shows a series of growth plates 12, that may be stacked and with a mesh cover that is placed over the plates.

25 As seen in figure 3, the aquatic cultivator 12 has a bore 32 which allows a tether line or cable 20 to pass therethrough. As seen in Fig. 7, apparently the aquatic cultivator 12 is held in place by putting a knot 22 in the line 20.

U.S. 5,511,514 Hichins et al, shows a system in which shellfish which do not attach to support means are raised in the

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same housing with the shellfish have attached. There is a rope 5 and an outer mesh housing tube that holds shellfish that can secure themselves to the rope and shellfish who can not secure themselves to the rope.

5           The description discloses a method of cultivating juvenile shellfish that are passed from a hopper 2 into the stocking 4. The culture rope 5 supports the structure and is apparently tied off at the lower portion.

10           U.S. 4,594,965 Asher et al, show a means for carrying out in the aquaculture in which there is a tube 31, and a series of dividers 32 that create growing chambers 33. The patent relates to the use of electric fields in the system.

15           As seen in Fig. 1 the fence 11 carries an electric potential to ward off unwanted marine life. The conduit 12, as seen in Fig. 2, is made from a flexible material and contains a plurality of tubes 14 -- 18 therein. Each of these tubes 14 -- 18 caring different amounts of nutrients which are described in column 3,lines 10+.

          U.S. 3,741,159 Halaunbrenner, shows a series of baskets that are joined and hung under water for the growth of shellfish.

20           As seen in figure 3, the baskets float and are held down by weights 29. As seen in figs. 6 -- 7, the pots 40 are placed in compartments 41 of the baskets 11 -- 14.

          U.S. 3,572,292 Quayle et al, shows a series of platforms or oyster bed clutches that are in the form of disc like elements that are secured in a series a line 34, such as shown in Figs 6, and 7.

25           As seen in Fig. 7 the clutch 10 is supported by the base portion 39 which is rigidly attached to the rope 34. The clutches are positioned so that the clutch immediately above and below each clutch is 90 degrees in the horizontal plane (see 11a in Fig 7).

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Figs. 6 shows the clutches stacked in a manner where they are all in the same relative orientation and the knobs 30 and 31 provide separation.

U.S. 249,942 Hughes, shows an oyster raising system in which a scow, with adjustable buoyancy, is provided with slats "F", that support layers of oysters, so the bottom layers are not crushed.

The background art fails to disclose a support structure that can be retrofitted to existing cultivating nets where proper support is provided for aquatic mussels so that you not become this attached from the net and hence is not retrievable for the aquatic farmer.

### SUMMARY OF THE INVENTION

The invention relates to an improved method and device to give support to aquacultured mussels that are clinging to a mesh tubing, rope or similar structure. In general the device (herein referred to the 'mussel support', 'support structure', 'mussel support structure' or 'mussel support disc') comprises a support portion, a clearance gap and a support extension. The support portion is a circular shape in the preferred embodiment (however it could be square, rectangular etc.) and covers more surface area in the horizontal plane to provide adequate support for growing aquatic mussels. The clearance gap is of sufficient tangential width to allow the support portion to be substantially concentric with the mesh tubing. The support extension is positioned in the clearance gap and is designed to extend through the mesh tubing and support the entire mussel support structure in a specific location along the length of mesh tubing. In the preferred form, the support extension has locking teeth that allow for easy insertion into the mesh and not easily removed.

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### BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a side view to a mussel growing operation where three stages of mussel development with respect to time where the left most mussel assembly are freshly inserted seed mussels into the mesh tubing lowered into the sea and the right most illustrates fully developed mussels;

Figure 2 is a cross-sectional top view of a support structure inserted through and net;

Figure 3 is a horizontal cross-sectional view of the support structure and net taken then line 3 -- 3 in Fig. 2;

Figure 4 schematically shows a method of cultivating mussels where a hopper inserts seed mussels into the mesh tubing and the supports are placed at vertically spaced intervals as the assembly is lowered into the ocean;

Figure 5 is a view of a second embodiment of the present invention where the mesh tubing is not employed and only a rope is provided for the mussels to cling thereon.

### DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS OF THE PRESENT INVENTION

As seen in Figure 1, a mussel growing operation comprises numerous vertical mesh tubings that are submerged in the water. Numerous mussel supports 20 are inserted about 12 – 18 inches vertically from each other to each mesh tubings 68 throughout the entire length of the mesh tube.

To facilitate the description of the support apparatus and the method of cultivating aquatic mussels, an axis system is defined whereas seen in Fig. 2, the arrow 10 indicates a longitudinal direction where the arrow points in a forward direction and the arrow 12 indicates a lateral direction. As seen in figure 3, the arrow 14 indicates a vertical axis.

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As seen in Figure 2, the mussel support (or support structure) 20 comprises a support portion 22 and a support extension 24. In general, the support structure 20 has a forward region 26, a rearward region 28, lateral regions 30 and 32. Further, the support structure 20 has a radial inward portion generally defined as 34 and a radial outward portion 36 defined as the radially outward portions from the radial inward portion of the support apparatus 20.

In the preferred form, the support portion 22 is rounded and has an upper support surface 38 and a bottom surface 40. Radial extensions (ribs) 42 extend radially and help provide strength and rigidity for the support portion 22. A surface 44 defines a gap portion 46 is a U-shaped cut out that has a width 48 which is a sufficient distance to allow for the diameter of the mesh tubing 68 to horizontally slide thereinbetween. Located in the radially outward portions 36, is an annular flange 48 that has a vertical heights slightly greater than the average thickness of the support portion 22. The annular flange 48 provides additional strength and rigidity for the apparatus 20.

The support extension 24 has a forward portion 50, a middle portion 52 and a base portion 54. The base portion 54 is rigidly attached to the radially inward portion 34 of the support portion 22. In the preferred form the support extension 24 and support portion 22 are a unitary structure where the preferred manufacturing technique is described further herein.

The support extension 24 further has a locking assembly 56 that comprises a plurality of locking teeth 58. The locking teeth 58 have a locking surface 60 that is adapted to engage the mesh tubing 68 described further herein. The extension 26 is adapted to be inserted through the mesh tubing 68. The surface portion 44b is



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rounded and adapted to rest against the mesh tubing 68. Locking teeth 58 allow for the support extension to be easily inserted into the web netting; however, the lock surface 60 engages the web netting to prevent accidental removal of the mussel disc 20 from the mesh tubing 68 due to such natural activity such as the tidal currents and mussel activity.

There will now be a general discussion of the method of cultivating shellfish namely mussels. As seen in figure 4, there is a hopper 62 that is adapted to receive juvenile mussels 64. The hopper 62 has a nozzle extension 66 that is adapted to fill mesh tubing (or harvesting support) 68. Hopper assemblies such as 62 are well-known in the art as well as methods of inserted juvenile mussels into a mesh tubing.

When the mesh tubing 68 is filled with seed mussels, a mussel support 20 is inserted through the tubing as shown in Figure 4. The locking teeth 58 of the support extension 24 slide through the holes of the mesh tubing 68. Support apparatus is 20b and 20c as seen in Figure 4 shows the mussel support 20 fully inserted through the mesh tubing 68. When the mussel support 20 is fully inserted the center of the mussel support is approximately concentric with the center of the mesh tubing 68 with the seed mussels contained therein (see Figure 1 and 4) the support portion 22 is in a position provide a base for the mussels immediately above the mussel support 20. In one form of the present invention in the center portion of the mesh tubing is a rope 71. The rope 71 can be a nylon three-way weave where the support extension 24 is threaded therethrough and the rope provides additional support.

After (or while) the supports 20 are inserted into the mesh tubing 68, the mesh tubing 68 is gradually lowered into the ocean water. When all of the mesh tubing has been filled with seed (or

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juvenile) mussels and the supports have been inserted into the mesh tube, the mesh tubes are lowered and the mussel culture looks something like the cultivating assembly 70a as shown in the left most portion of Figure 1.

5           Figure 1 illustrates a mussel cultivating operation where there is a support structure 72 comprising horizontal support members 74 and floats 76. The cultivating assemblies 70 are fastened to the support members 74 by any conventional method. In operation, there could be hundreds of cultivating assemblies 70  
10   harvesting mussels 71.

Each mussel support 20 and the mussels thereabove to just below the next adjacent mussel support 20 is referred to as a mussel section 78. As the seed mussels grow, each mussel support 20 will provide support to the mussels immediately  
15   thereabove (see cultivating assembly 70b). The weight of the mussels on the support is transferred to the mesh tubing 68 through support extension 24. So each mussel support 20 will provide a base for the mussels thereabove up to the next mussel support 20.

To illustrate the benefits of the support apparatus 20, let us  
20   assume that a mussel (indicated at 71) loses its foothold. With the invention employed, this occurrence only effects the mussels in the respective mussel section 78a. In other words, the mussels located at vertically above support 20d are not affected by the failure of a mussel located therebelow. Further, using the mussel support  
25   reduces the weight upon the mussels located in the bottom portion of the twenty some feet of mesh tubing 68 which reduces the chances of catastrophic failure where large numbers of mussels are lost to the bottom of the ocean bay.

In the preferred form the support apparatus 20 is circular in  
30   the horizontal plane; however, in the broader scope of the invention

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other shapes could be designed without departing from the teachings of the invention. Further, the preferred form shows a support disc (apparatus) 20 that is substantially planar; however, in the broader scope of the invention other shapes could be employed  
5 such as a frustoconical disc with an upward slope. The preferred method of manufacturing the support apparatus 20 is plastic injection with a polyurethane blend plastic. However, other methods could be employed such as a stamping manufacturing means.

10 Figure 5 shows a second embodiment of the present invention where the disk 20 is inserted through a rope (or harvesting support) 100. The rope 100 can be a three strand rope where the support extension 24 passes there in between the rope strands. Any conventional rope can be employed. In this  
15 embodiment the mussels can actually grow on the rope 100 to full maturity. When the mussels are fully mature the aquatic farmer can extract the rope from the ocean and cultivate the mussels. This embodiment reduces the need of culturing seed mussels and reasserting them into the sea inside the mesh tubing. The support  
20 the apparatus 20 will still provide support to the growing mussels as they mature. The support apparatuses 20 can likewise be spaced vertically along the rope 100 in intervals of 12 inches to 18 inches and even as high as 24 inches in some applications.

While the invention is susceptible of various modifications  
25 and alternative forms, specific embodiments thereof have been shown by way of example in the drawings as described in detail. It should be understood, however, that it is not intended to limit the invention to the particular forms disclosed, but, on the contrary, the intention is to cover all modifications, equivalents and alternatives  
30 falling within the spirit and scope of the invention as expressed in

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the appended claims. It is desired that the embodiments described above may be considered in all respects as illustrative, not restrictive, reference being made to the appended claims to indicate the scope of the invention.

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I claim:

1. A support apparatus adapted to be positioned in a mussel  
growing operation having a mesh tubing that are  
5 substantially filled with aquatic mussels, where the support  
apparatus has a center portion, and upper portion and a  
lower portion and the support apparatus comprises:  
  
a surface defining a connector member having a front  
portion and a base portion where the base portion is  
10 rigidly attached to the center portion of the support  
apparatus, the surface further defining an open area  
immediately to the adjacent sides of the connector  
member,  
  
whereas the connector member is adapted to be  
15 positioned through a portion of the mesh tubing and the  
upper surface of the support apparatus is adapted to  
support the said aquatic mussels.
2. The apparatus as recited in claim 1 further comprising:  
  
where the upper surface defines radially extending  
20 support ribs.
3. The apparatus as recited in claim 1 further comprising:  
  
a locking system located on the connector member that is  
adapted to engage the mesh tubing and hold the  
apparatus thereto.
- 25 4. The apparatus as recited in claim 3 further comprising:

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where the upper surface defines radially extending support ribs.

5 5. The apparatus as recited in claim 1 where the apparatus is substantially cylindrical in the plane orthogonal to the vertical axis.

6. A method of cultivating aquatic mussels comprising the steps of:

10 inserting seed mussels from a hopper into a mesh tubing;  
inserting a support apparatus at spaced intervals along the mesh tubing;  
placing the mesh tubing into the ocean for purposes of growing and harvesting aquatic mussels;  
whereas, the support apparatus provides support for growing mussels.

15 7. A support apparatus adapted to be positioned in a mussel growing operation having a harvesting support that is adapted to grow aquatic mussels, where the support apparatus has a center portion, and upper portion and a lower portion and the support apparatus comprises:

20 a surface defining a connector member having a front portion and a base portion where the base portion is rigidly attached to the center portion of the support apparatus, the surface further defining an open area immediately to the adjacent sides of the connector member,  
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whereas the connector member is adapted to be positioned through a portion of the harvesting support and the upper surface of the support apparatus is adapted to support the said aquatic mussels.

5     8. The apparatus as recited in claim 7 further comprising:

where the upper surface defines radially extending support ribs.

9. The apparatus as recited in claim 7 further comprising:

10     a locking system located on the connector member that is adapted to engage the harvesting support and hold the apparatus thereto.

10. The apparatus as recited in claim 7 further comprising:

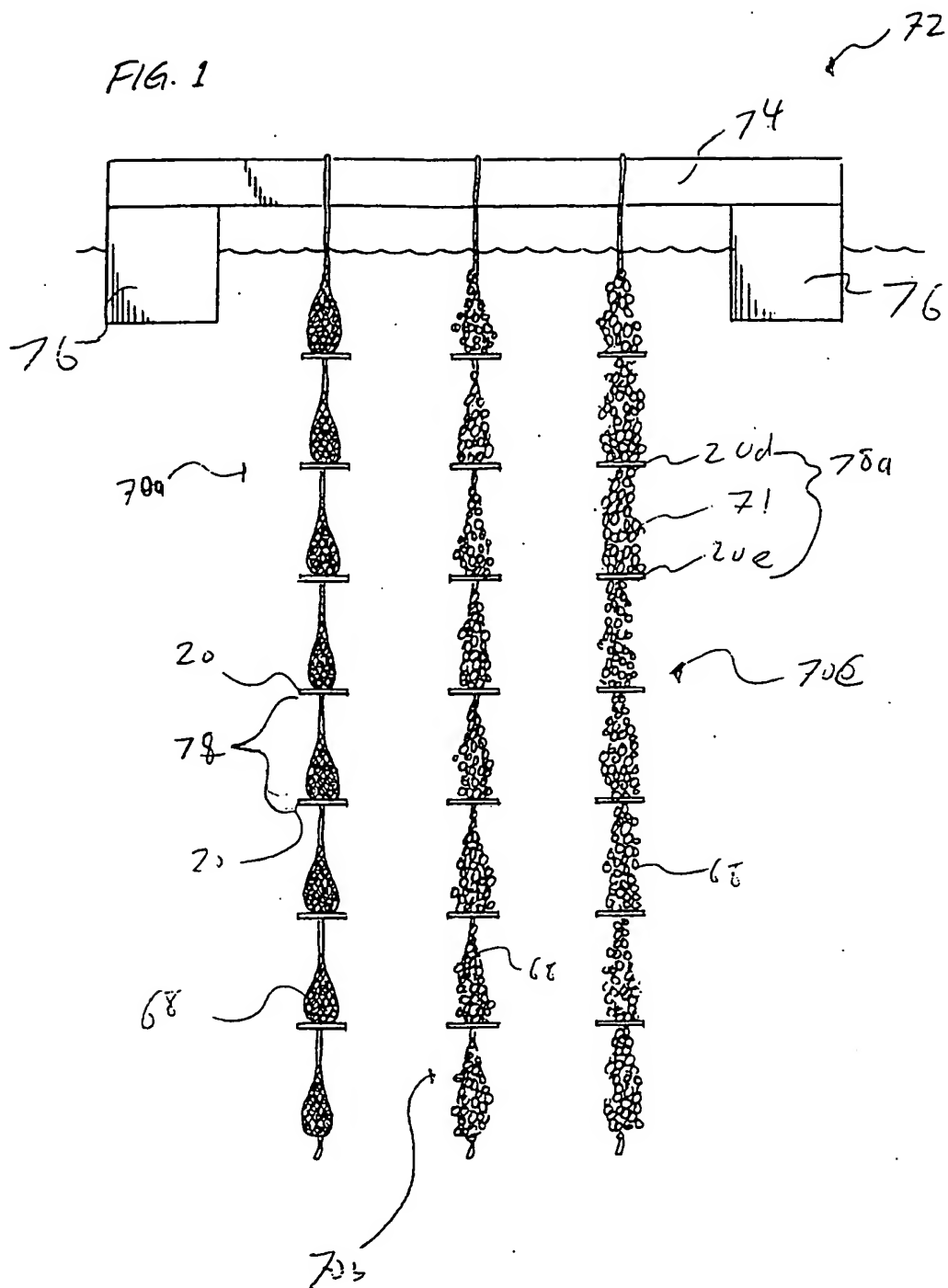
where the upper surface defines radially extending support ribs.

15     11. The apparatus as recited in claim 7 where the apparatus is substantially cylindrical in the plane orthogonal to the vertical axis.

12. The apparatus as recited in claim 9 further comprising:

20     a locking system located on the connector member that is adapted to engage the harvesting support and hold the apparatus thereto.

13. The apparatus as recited in claim 10 where the apparatus is substantially cylindrical in the plane orthogonal to the vertical axis.





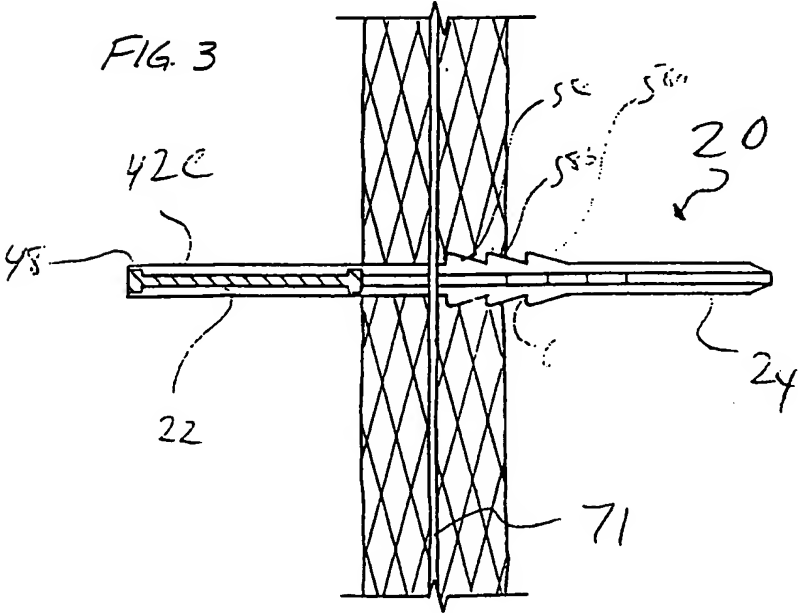
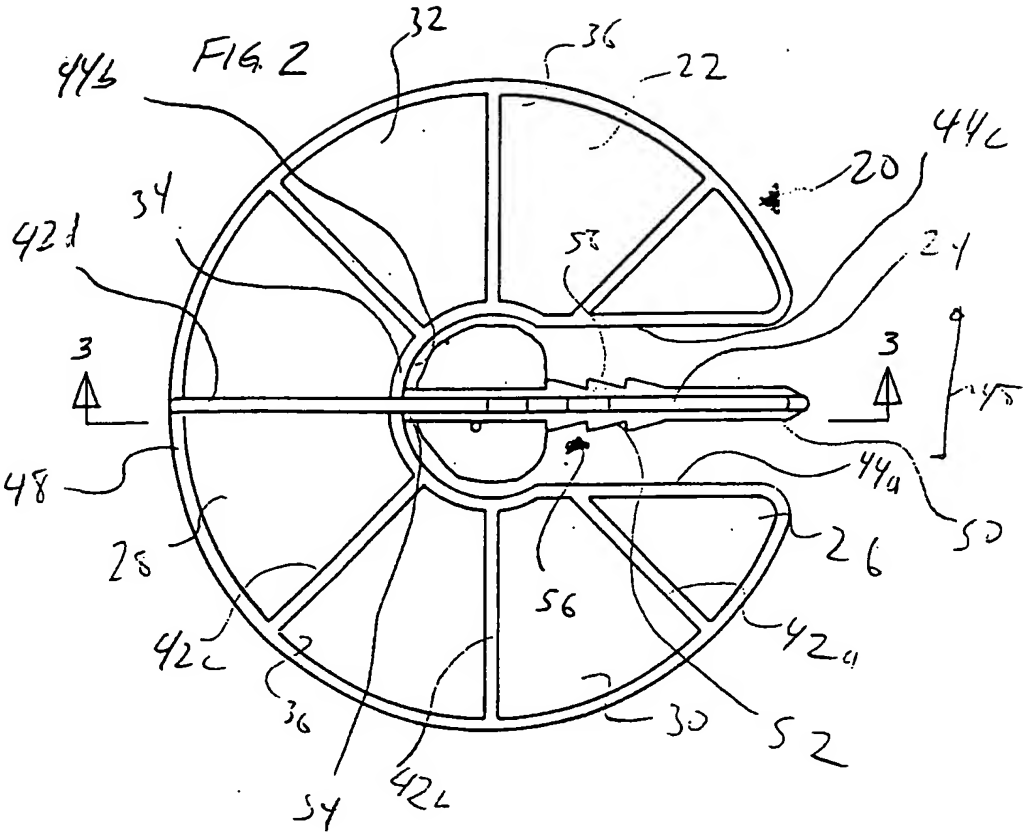


Fig. 4

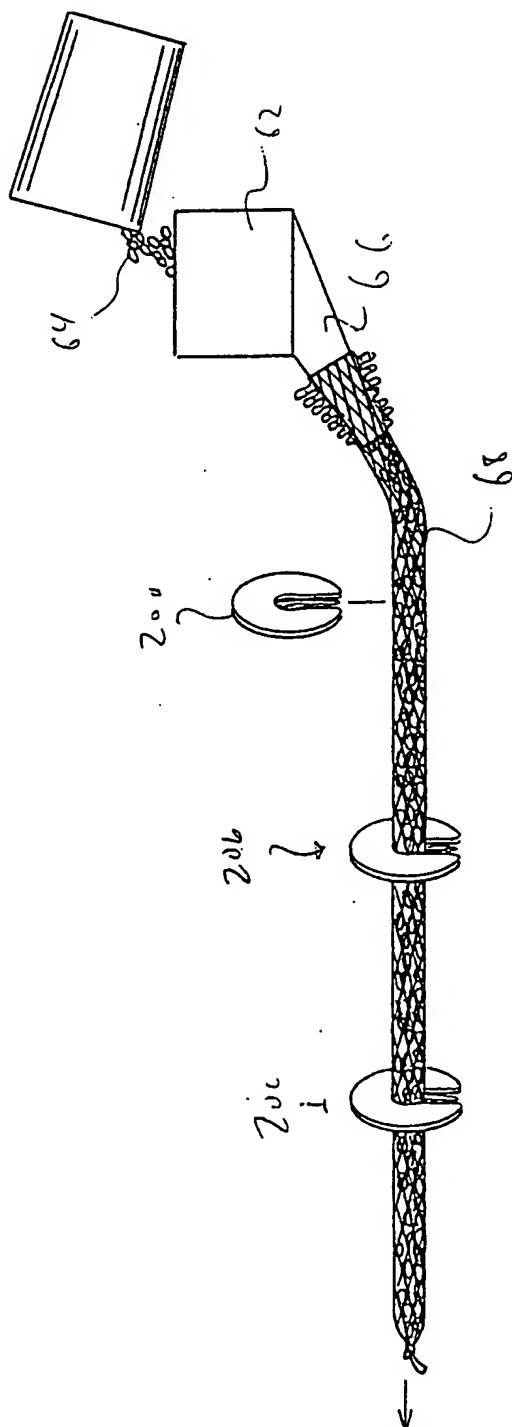
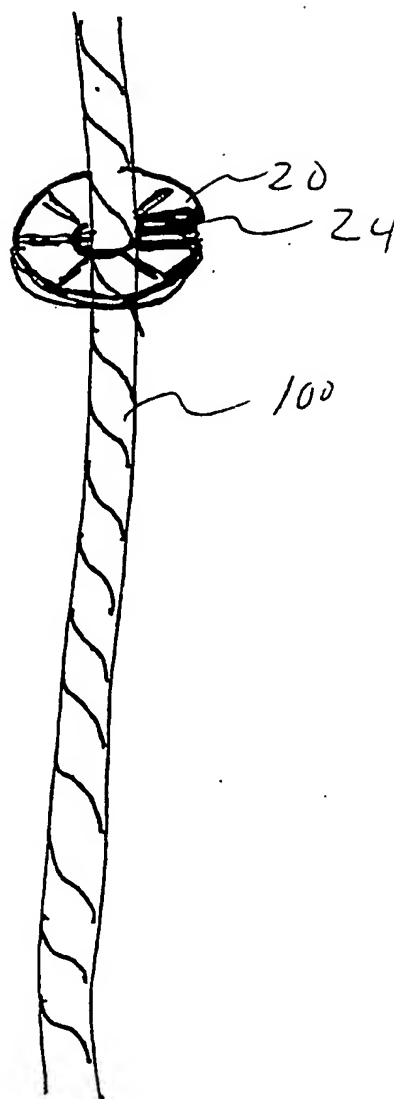


Fig 5



## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US00/26801

**A. CLASSIFICATION OF SUBJECT MATTER**

IPC(7) : A01K 61/00  
 US CL : 119/234, 238, 239

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 119/234, 238, 239, 200, 236, 237, 240, 241, 206, 208

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
 EPO, JPO and Derwent with the above US class/subclass search.

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3,811,411 A (MOELLER) 21 May 1974 (21.05.1974), see entire document and figure 6	6
X	US 2,853,049 A (GLANCY) 23 September 1958 (23.09.1958), see entire document and figures 1, 2.	1, 3, 7, 9, 12
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Y		2, 4, 5, 8, 10, 11, 13
A	US 5,511,514 A (HITCHINS ET AL.) 30 April 1996 (30.04.1996), see abstract and figure 1.	6
Y	US 5,443,682 A (EDMONDS ET AL.) 22 April 1995 (22.04.1995), see abstract, col. 6, lines 50-60 and figure 1.	2, 4, 5, 8, 10, 11, 13
A	US 5,515,813 A (WILKERSON) 14 May 1996 (14.05.1996), see abstract and figures 1-3.	1-5, 7-13
A	US 4,377,987 A (SATRE) 29 March 1983 (29.03.1983), see abstract and figures 1-4.	1-5, 7-13
A	FR 2,589,323 A1 (GILBERT) 07 May 1987 (07.05.1987), figures 1, 2	6
A	GB 2,242,811 A (FRASER ET AL.) 16 October 1991 (16.10.1981), see abstract and figure 1.	1-5, 7-13

☐ Further documents are listed in the continuation of Box C.

☐ See patent family annex.

* Special categories of cited documents:	
"A" document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family
"P" document published prior to the international filing date but later than the priority date claimed	

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